Research into the Development of a Knowledge Acquisition Taxonomy: Monthly Progress Reports

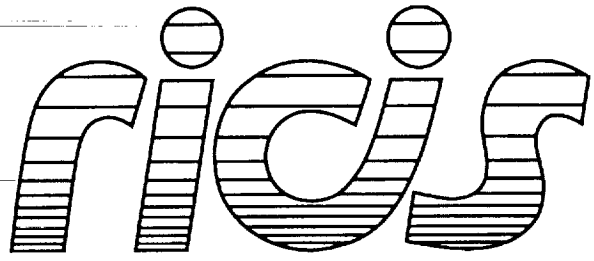
Pamela K. Fink

Southwest Research Institute

9/90 - 1/91

Cooperative Agreement NCC 9-16
Research Activity No. ET.26

NASA Johnson Space Center
Mission Operations Directorate
Space Station Training Office



Research Institute for Computing and Information Systems
University of Houston-Clear Lake

INTERIM REPORT

The RICIS Concept

The University of Houston-Clear Lake established the Research Institute for Computing and Information Systems (RICIS) in 1986 to encourage the NASA Johnson Space Center (JSC) and local industry to actively support research in the computing and information sciences. As part of this endeavor, UHCL proposed a partnership with JSC to jointly define and manage an integrated program of research in advanced data processing technology needed for JSC's main missions, including administrative, engineering and science responsibilities. JSC agreed and entered into a continuing cooperative agreement with UHCL beginning in May 1986, to jointly plan and execute such research through RICIS. Additionally, under Cooperative Agreement NCC 9-16, computing and educational facilities are shared by the two institutions to conduct the research.

The UHCL/RICIS mission is to conduct, coordinate, and disseminate research and professional level education in computing and information systems to serve the needs of the government, industry, community and academia. RICIS combines resources of UHCL and its gateway affiliates to research and develop materials, prototypes and publications on topics of mutual interest to its sponsors and researchers. Within UHCL, the mission is being implemented through interdisciplinary involvement of faculty and students from each of the four schools: Business and Public Administration, Education, Human Sciences and Humanities, and Natural and Applied Sciences. RICIS also collaborates with industry in a companion program. This program is focused on serving the research and advanced development needs of industry.

Moreover, UHCL established relationships with other universities and research organizations, having common research interests, to provide additional sources of expertise to conduct needed research. For example, UHCL has entered into a special partnership with Texas A&M University to help oversee RICIS research and education programs, while other research organizations are involved via the "gateway" concept.

A major role of RICIS then is to find the best match of sponsors, researchers and research objectives to advance knowledge in the computing and information sciences. RICIS, working jointly with its sponsors, advises on research needs, recommends principals for conducting the research, provides technical and administrative support to coordinate the research and integrates technical results into the goals of UHCL, NASA/JSC and industry.

Preface

This research was conducted under auspices of the Research Institute for Computing and Information Systems by Dr. Pamela K. Fink of the Southwest Research Institute. Dr. Glenn B. Freedman served as RICIS research coordinator.

Funding has been provided by the Mission Operations Directorate, NASA/JSC through Cooperative Agreement NCC 9-16 between the NASA Johnson Space Center and the University of Houston-Clear Lake. The NASA technical monitor for this activity was Barbara N. Pearson, of the Systems/Elements Office, Space Station Training Office, Mission Operations Directorate, NASA/JSC.

The views and conclusions contained in this report are those of the author and should not be interpreted as representative of the official policies, either express or implied, of NASA or the United States Government.

SOUTHWEST RESEARCH INSTITUTE

POST OFFICE DRAWER 28510 • 6220 CULEBRA ROAD • SAN ANTONIO, TEXAS, USA 78284 • (512) 684-5111 • TELEX 244846

September 11, 1990

Intelligent Systems Evaluation
Training Systems Division
AFHRL/ID
Brooks AFB, TX 78235

Attention: Kurt Steuck, Ph.D.

Subject: Monthly Progress Report from August 20 through August 31, 1990; Research Activity No. ET.26; NASA Cooperative Agreement NCC9-16; Southwest Research Institute (SwRI) Project No. 05-3744

Gentlemen:

Southwest Research Institute was put under contract to perform the proposed work in developing a knowledge engineering taxonomy on August 20, 1990. Dr. Pam Fink and Dr. Tandy Herren met with Kurt Steuck and Capt. B.J. Jones of HRL on August 28, 1990 to discuss the goals, direction, and schedule of the project. We also began generating a list of potential problem solving tasks that could be considered for closer examination during the course of the project. Our first task is to identify a set of specific problem solving tasks, along with at least one human source of expertise in each area. A preliminary list has been generated. In order to support selection of an appropriate and representative set of problem solving tasks, we are examining existing problem solving and learning taxonomies. These taxonomies are being used to generate a large matrix of tasks along one axis and attributes of tasks, such as reasoning methods, sources of data, problem solving environment, etc., along the other. The selected set of problem solving tasks should cover a large portion of this matrix.

During the next reporting period we will complete the selection of a set of problem solving tasks. We will also begin the design of the interview sessions to be performed with the experts. Issues to be resolved include:

- interviewing one domain expert in each area twice or two domain experts in each area once,
- performing all interviewing for a given problem solving task at one time or perform preliminary interviews with each expert first and then return for a second interview, and
- what knowledge engineering techniques should be used in each case.

Expenditures for this reporting period totaled $1,862.23, leaving a balance of $64,046.77 of the original $65,909 contract amount.

Approved:

Richard B. Curtin
Vice President
Automation & Data Systems
Division

Sincerely,

Pamela K. Fink, Ph.D.
Manager
Artificial Intelligence
Section

RBC/PKF/em

Enclosures

cc: Nancy Bell, RICIS
Bill Bayliss, SwRI
Tandy Herren, SwRI

SOUTHWEST RESEARCH INSTITUTE

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October 10, 1990

Intelligent Systems Evaluation
Training Systems Division
AFHRL/ID
Brooks AFB, TX 78235

Attention: Kurt Steuck, Ph.D.

Subject: Monthly Progress Report from September 1 through September 28, 1990; Research Activity No. ET.26; NASA Cooperative Agreement NCC9-16; Southwest Research Institute (SwRI) Project No. 05-3744

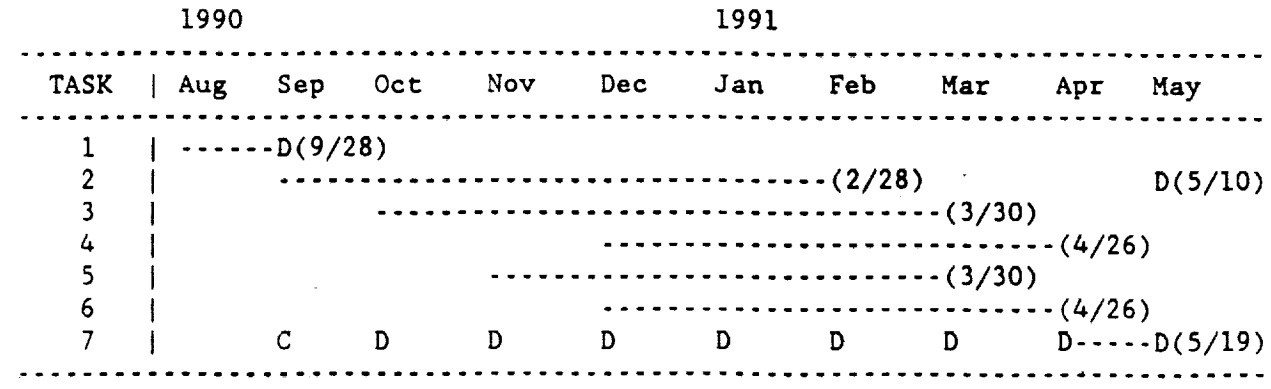
Gentlemen:

The emphasis during this reporting period has been on the generation of three lists: 1) a list of possible problem solving tasks/jobs to be considered, 2) a list of task characteristics to be utilized in an initial attempt to discriminate between different problem solving tasks, and 3) a list of knowledge acquisition techniques, both automated and non-automated. The list of possible problem solving tasks consists of approximately 35 jobs ranging from equipment diagnosis to facility management to chemical analysis. The list attempts to capture as many different areas of problem solving that are of interest to the Air Force and NASA as possible. The list of problem solving task characteristics consists of approximately 16 major categories of issues, including reasoning techniques used, inputs available, motor processes required, and the environment in which the task is performed. Each of these major areas includes a number of sub-characteristics. For example, reasoning techniques include statistical, spacial, temporal, analogical, case-based, modelling, mathematical, deductive, and inductive. The list of knowledge acquisition techniques includes non-automated, or traditional, techniques such as written materials, verbal reports, and psychometric techniques, as well as automated techniques where approximately 40 tools categorized as either induction-based or interview-based are enumerated.

Once all of these lists were generated, a meeting was held on September 26 at HRL between Pam Fink, Tandy Herren, Kurt Steuck, and B.J. Jones concerning the completeness of the lists and the planned approach for utilizing them. A number of additional problem solving tasks/jobs were added, and the issue of communication was added to the task characteristics list. Based on the feedback from this meeting, a large matrix will be generated that crosses problem solving tasks/jobs with problem solving task characteristics. Check marks will be placed in the appropriate boxes indicating which characteristics are relevant to which tasks/jobs. A copy of this matrix is due to be sent to Dr. Steuck and Capt. Jones around October 3. This matrix will be reviewed and modified as appropriate and will then be used to support selection of the 10-12 problem solving tasks/jobs for further study. A meeting is set for October 12.

SCHEDULE FOR RESEARCH IN DEVELOPMENT
OF A KNOWLEDGE ENGINEERING TAXONOMY

Months from Date of Award



List of Tasks:

Task 1 - Identification of a Set of Specific Problem Solving Tasks

Task 2 - Definition of Identified Problem Solving Tasks

Task 3 - Analysis of Identified Problem Solving Tasks

Task 4 - Development of a Proposed Taxonomy of Problem Solving Tasks

Task 5 - Analysis of Knowledge Engineering Techniques Used in Task 2

Task 6 - Matching of Knowledge Engineering Techniques to Problem Solving Tasks

Task 7 - Reporting

Based on the original schedule, we were to have selected the 10-12 tasks/jobs by September 28 (Task 1). However, in order to do a better job of selecting a set of representative tasks, we have placed more emphasis up front on defining and analyzing the problem solving tasks (Tasks 2&3). Based on the meeting set for October 12, we will make a selection of the 10-12 tasks and begin scheduling interviews. The schedule has been modified to reflect this change. We hope that having some knowledge up front of the various tasks, in terms of the type of problem solving that is performed, will allow for a more representative selection of tasks for further study. We also believe that such knowledge will be helpful in designing the interviews to be performed with the domain experts. Currently, we plan to perform interviews in two stages. The first stage will involve a high-level interview to better define each task in terms of the list of problem solving characteristics and to refine the list of characteristics. The second stage will then attempt to match knowledge acquisition techniques based on the characteristics and assess the results.

Expenditures for this reporting period totaled $3,317.95, leaving a balance of $60,728.82 of the original $65,909 contract amount.

Approved:

Richard B. Curtin
Vice President
Automation & Data Systems
Division

Sincerely,

Pamela K. Fink, Ph.D.
Manager
Artificial Intelligence
Section

RBC/PKF/em

Enclosure

cc: Nancy Bell, RICIS
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SCHEDULE FOR RESEARCH IN DEVELOPMENT
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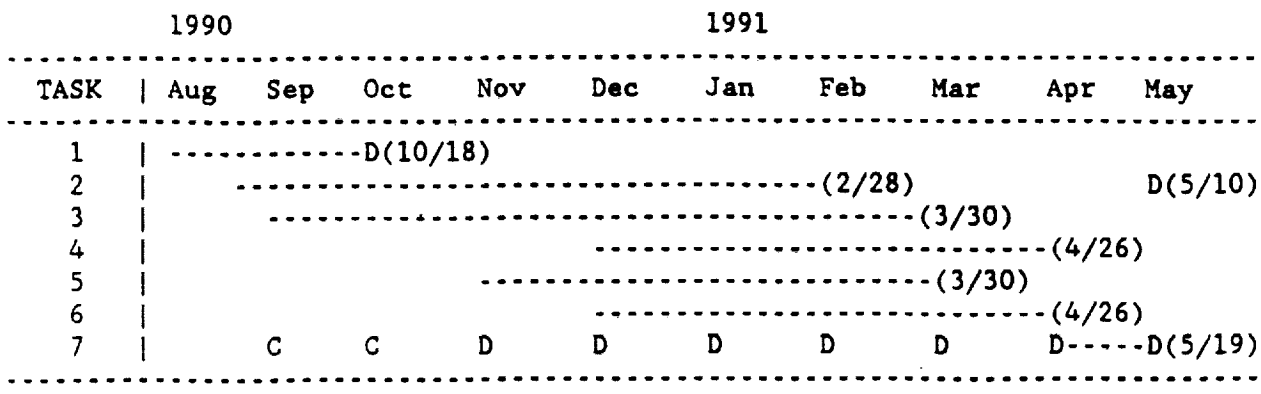

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SOUTHWEST RESEARCH INSTITUTE

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November 9, 1990

Intelligent Systems Evaluation
Training Systems Division
AFHRL/ID
Brooks AFB, TX 78235

Attention: Kurt Steuck, Ph.D.

Subject: Monthly Progress Report from September 29 through October 26, 1990; Research Activity No. ET.26; NASA Cooperative Agreement NCC9-16; Southwest Research Institute (SwRI) Project No. 05-3744

Gentlemen:

A copy of the matrix crossing problem characteristics with selected tasks was mailed to Brooks for review on October 2, 1990. This matrix served as our basis for discussion in a meeting held between Dr. Kurt Steuck, Capt. B. J. Jones, Dr. Tandy Herren, and Dr. Pam Fink on October 12. Based on this meeting, a set of tasks were selected and responsibilities assigned concerning who was to provide a contact. The list of tasks initially analyzed, a list of distinctive task types, and the list of tasks selected for further analysis are attached. Some experts have been identified and some initial interviews have taken place. These are indicated by the names and dates listed with the specific tasks. These initial interviews have been based on a questionnaire designed to help us better define the values that should be placed next to particular task characteristics for the given task. A copy of the questionnaire is attached. When we interview, we do not go through the entire questionnaire but use it as a guide to ensure that we get all of the information we need. Questions marked with a "**" indicate we believe these are key questions.

During the next reporting period, we plan on setting-up and carrying-out the initial interviews not yet performed. Based on the initial interview, we are re-doing the problem characteristics for each selected task and using a scale of 0-4, 0 indicating not important and 4 indicating key importance to the particular task.

Expenditures for this reporting period totaled $5,351.22, leaving a balance of $55,377.60 of the original $65,909 contract amount.

Approved:

for Richard B. Curtin
Vice President
Automation & Data Systems
Division

Sincerely,

Pamela K. Fink, Ph.D.
Manager
Artificial Intelligence
Section

RBC/PKF/em

Enclosure

cc: Nancy Bell, RICIS
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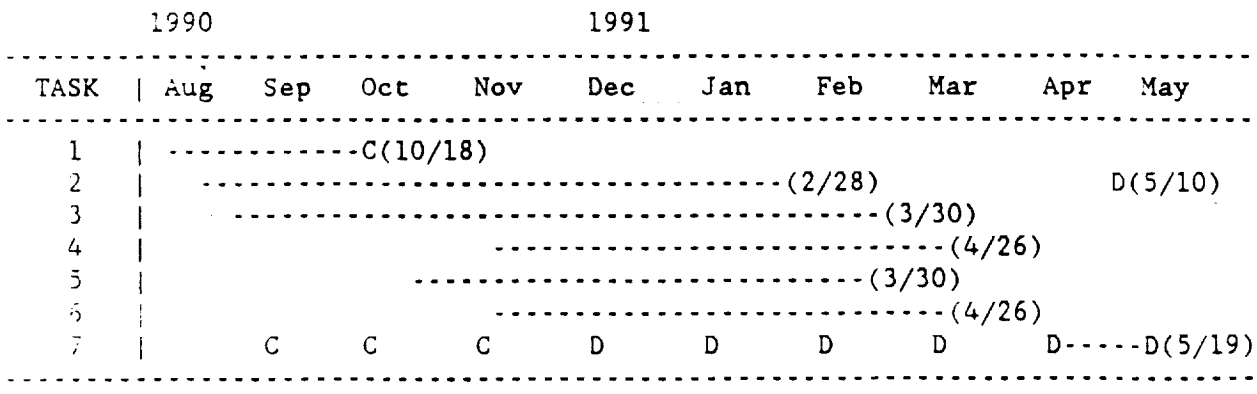
Tandy Herren, SwRI

SCHEDULE FOR RESEARCH IN DEVELOPMENT
OF A KNOWLEDGE ENGINEERING TAXONOMY

Months from Date of Award



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TASK/JOB LIST FOR KNOWLEDGE ENGINEERING TAXONOMY

The following is a list of the tasks/jobs initially identified for a preliminary analysis:

1. maintain systems/diagnostics
2. repair systems/making the fix
3. communications monitoring/analysis
4. photo analysis
5. training pilots
6. training astronauts
7. training air crews (groups to work together)
8. training instructors
9. air traffic control
10. console operations
11. weather forecasting/modelling
12. program management
13. facilities management
14. cargo loading
15. operating a piece of equipment
16. software design
17. software maintenance/debugging
18. form fill-out
19. training reading
20. training foreign language
21. oil accident investigation
22. prospecting
23. power grid management

24. computer configuration
25. chemical analysis
26. personnel management
27. customer service
28. sales
29. weapons director/air intercept
30. use RMS/other remote manipulator
31. leadership training
32. surgery
33. medical diagnosis
34. accounting
35. marketing/advertising
36. knowledge engineering
37. scientific protocol design

Based on the preliminary analysis, a set of distinctive attributes about tasks became apparent. The set of tasks that should be analyzed further should include at least one representative of each of the following:

1. diagnostic task
2. training task
3. high performance task
4. form fill-out
5. people-oriented (soft) task
6. design task
7. planning task
8. monitoring with a time factor
9. perceptually-oriented task
10. bin-packing/np-complete task

11. numerical task

12. data intensive (no real time factor), ie. acquire and present

The following is the list of selected tasks/jobs for which an initial interview will be performed (dates indicate date of initial interview):

1. **(diagnositcs)** medical diagnosis - HRL

2. **(diagnostics)** equipment diagnosis - ??

3. **(training)** training pilots - HRL/Randolph

4. **(training)** training a foreign language - HRL

5. **(high performance)** flight controller console operations - Matt Barry, NASA/JSC - early Nov.

6. **(high performance/KR)** surgery - HRL/BAMC

7. **form fill-out** - Bill Bayliss, SwRI Contracts - Oct. 26, 1990

8. **(people-oriented)** personnel management - HRL/CBPO

9. **(design)** sofware design - Susan Crumrine, SwRI - ??

10. **(planning)** acquisition program management - Xavier Pena, Kelly AFB - ??

11. **(monitoring/time)** air traffic control - David Settle, FAA - Nov. 1, 1990

12. **(perceptual)** ??

13. **(bin-packing)** cargo loading - HRL/Kelly

14. **(numerical)** accounting - Linda Boehme, SwRI CPA - ??

15. **(data intensive/no time)** ??

16. **(??)** communications analysis - HRL/ESC

17. **(??)** chemical analysis - HRL/OEHL drug testing

A9) When you are defining/identifying the problem, do you spend alot of time looking up information or thinking about different aspects of the problem or do you perform the task mostly automatically? What types of interactions, if any, are required in terms of documents, data systems, or other people when performing problem definition?

**A10) What types of information come to mind when you do the task in the sense of inputs into the problem?

- facts
- principles/rules/laws
- procedures
- similar problems/analogies
- past problems

A11) Do you interact with other people while you're defining the problem? If so, how?

Do you:

- advise
- answer
- direct
- indicate
- inform
- instruct
- request
- transmit
- supervise

A12) Do you think body language such as gestures and facial expresssions are important in communicating at this time?

**A13) Is there alot of uncertainty in the problem -- maybe even to the extent that it's hard to know if there is a problem? How do you go about identifying/defining the problem?

A14) Do the problem characteristics change frequently, maybe even while you're solving it? If so, what changes -- data, rules by which you solve the problem? What drives the change - e.g., time intervals?

**A15) Do you have to solve the problem quickly or are there other constraints on the problem? e.g., Is time a factor - what is "real-time" in this situation -- seconds, minutes, hours? How flexible are any constraints on the problem?

**A16) Do you use solutions to past problems to help you solve the current problem? How similar do they tend to be and how do you modify them?

A17) How do you decide what past problem to use? Do you use a specific problem or some general version?

A18) Do you try to draw parallels to similar but not identical problems,

Interview Questions

Initial Discussion:

There are no right answers or good answers to these questions. Some of the questions may be phrased so that you believe one or another response is appropriate or somehow better than another. For example, it may sound good to say you plan up front all your actions in solving a problem or doing the job even if some of those actions occur somewhat automatically. Please do not fall into this bias. For this example, it is good to plan but it is also good not to plan too much and to have some actions that occur automatically. We want to assess all aspects of your job with as much fidelity as possible. What results from these interviews will help us to better understand the unique aspects of your work and how we could learn more about it in the future so we can design computer systems that help you perform your job more easily.

Also, we want to assure you that under no circumstances will your answers go to your supervisor or anyone else outside of this room. You are responding to this questionnaire completely anonomyously. Because of this, we want you to provide the operational answers to these questions, not the official ones. We want to know what you really do on your job.

I. Understanding the Problem

(A1) Tell us a little bit about your field, yourself, and how you got into this field.

(A2) What initiates the problem solving process?

(A3) What types of inputs to the problem do you have? How do you recognize the problem?

- Do you
  - see something
  - hear something
  - talk to someone
  - feel something
  - read something -- book, test equipment, output computer display
  - detect it based on past data

(A4) Does solving the problem require alot of data? If so, about what and how do you acquire the data? Do you try to group data together into categories that have some unifying principle?

(A5) Is the data you work with primarily numerical or is it more qualitative?

(A6) What assumptions can be made that would simplify the problem solving task? What is the effect when these assumptions are removed?

(A7) What could happen to complicate the task?

(A8) Are there manuals or desk procedures that document/direct what you do?

see how those problems were solved, and use that information in the current problem?

(A20) What equipment do you use while defining the problem?

(A20) How many alternative answers are there for a problem? Do you have to check for many as you solve it? Is one answer obviously better than another? How can you tell? Must you find the best answer or is a certain level of answer good enough?

(A21) How would you describe the output of your task? Do you generate a document, a decision, a recommendation, an action, a piece of equipment, an interaction with someone, etc.?

(A22) Can you list all possible solutions to your problem at the start? If so, approximately how many are there?

B. Devising the Plan

(B23) When you think about a problem do you

a) visualize it in your mind
b) formalize it in a set of equations and work it out mathematically
c) explain it and solve it in English

B24) Do you calculate or look at statistics to help you solve the problem?

B25) Do you order elements of the problem in time or do you have to think about a time element during the solution? (i.e., such as data or input changing over time).

B26) Do you generate a model to help you solve the problem, such as a mathematical model, a physical model, or some other symbolic representation of the problem? Do you "simulate" the behavior of a device in your head.

B27) When you plan the job, do you spend alot of time looking up information or thinking about different aspects of the problem or do you perform the task mostly automatically? What types of interactions are required in terms of documents, data systems, or other people?

B28) Do you break the problem into parts? Are there sequential tasks you perform or logically distinct subcomponents of the problem? If so, what are they?

B29) When you plan the task, do you have to do one thing after another, such that one set of conditions causes you to respond with a whole series of actions? Do you wait after each one to see the results before you go any further?

B30) Do you interact with other people while planning the task? If so,

how?

Do you:

- advise
- answer
- direct
- indicate
- inform
- instruct
- request
- transmit
- supervise
- body language

B31) What type of formal education do you have? Both in general as well as specific to your job. What role does experience play? Do you have an apprenticeship? How do you become qualified for what you do?

B32) Do you think personal factors such as age, gender, height, or weight influence yours or others ability to do the task?

B33) Do you think you have to have a certain attitude or personality to work well on this job?

B34) Do you generate solutions and then test them to see if they work?

B35) Do you think of past solutions and then modify them to suit the current problem?

B36) Do you look at data and find the problem or a method, then look at more data, etc. Or do you have a goal and collect data to meet that goal?

B37) When you solve the problem do you have a goal and take incremental steps in an attempt to step by step get to that goal?

B38) Are there set procedures or formulas you use for your task?

B39) Are the procedures you use to solve the problem known?

B40) Do you gather data and then present it by writing about it or discussing it with others?

**B41) Do you break your problem into sub-parts and then solve those? After you solve the sub-parts do you have to reassemble them into an overall solution?

B42) Do you ever go back and return to the specifications or original definition of the problem?

B43) Do you generate solutions that explain part of the problem, and then determine what part is solved and try to generate a solution to solve

any remaining portions of the problem?

B44) During your task do you have to

- calculate
- code
- computerize
- interpolate
- itemize
- tabulate
- translate
- estimate
- compute

B45) Do you choose between alternatives? Do you compare alternatives?

B46) Do you integrate portions of the problem in the final solution?

B47) Do you have to do alot of planning? Plan the task -- or create a plan?

B48) Do you categorize parts of the problem together? Or categorize data in order to solve the problem?

B49) Are there general principles that you know to be true in your field? Do you use those to help determine what's going on in a specific situation?

**B50) If you make a wrong choice, is it easy to undo and if it is, how do you undo it?

B51) What equipment do you use when planning the problem solution?

C) Carrying Out the Problem

**C52) What are the major steps you perform?

C53) Where is your problem solving generally performed? Describe your work environment. Do you work at a desk with paper and pencil, at a console or in front of a piece of equipment, walking around and talking to people, or flying an aircraft?

Is there:

- acceleration
- confinement
- isolation
- contaminants - what are they?
- electricity
- lighting
- magnetism
- noise

C54) How demanding is the task physically and psychologically?

- fatigue
- mental strain
- stress
- physical strain
- precision
- amount of sleep
- work schedule
- have to pay attention all the time

C55) Do you have to pay close attention to the task for long periods of time?

C56) What types of physical movements do you make when you do the job?

(we will assess motor processes and perceptual requirements from the demonstration)

C57) Do you interact with other people during the actual execution of the task? How?

Do you:

- advise
- answer
- direct
- indicate
- inform
- instruct
- request
- transmit
- supervise
- body language

C58) When you do the job, do you spend alot of time looking up information or thinking about different aspects of the problem or do you perform the task mostly automatically? What types of interactions are required in terms of documents, data systems, or other people during task execution?

C59) Do you monitor some set of indicators as the task progresses?

C60) Do you have to interpret information you receive maybe forming new indicators?

C61) What type of equipment is involved in actually performing the task?

C62) When you perform the job, do you have to do one thing after another, such that one set of conditions causes you to respond with a whole series of actions? Do you wait after each one to see the results before you go any further?

**C63) What is the hardest/easiest thing you do? What is the most

important

D) Looking Back

**D64) How many alternative answers do you usually come up with? Do you have to check for many as you solve it? Is one answer obviously better than another? How can you tell? Must you find the best answer or is a certain level of answer good enough?

D65) Do you interact with other people in verifying the task? How?

Do you:

- advise
- answer
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D66) When you evaluate your solution, do you spend alot of time looking up information or thinking about different aspects of the problem?

D67) Can the quality of a solution be characterized as better or worse rather than acceptable/not acceptable?

SOUTHWEST RESEARCH INSTITUTE

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December 10, 1990

Intelligent Systems Evaluation
Training Systems Division
AFHRL/ID
Brooks AFB, TX 78235

Attention: Kurt Steuck, Ph.D.

Subject: Monthly Progress Report from October 27 through November 23, 1990; Research Activity No. ET.26; NASA Cooperative Agreement NCC9-16; Southwest Research Institute (SwRI) Project No. 05-3744

Gentlemen:

During this reporting period, we have set-up and performed some of the initial interviews in the areas agreed upon. We have scheduled meetings in planning (acquisition program management), monitoring with a time constraint (air traffic control), and high performance (shuttle flight control). We have performed the air traffic control interview. Based on the initial interview in each, we are re-doing the problem characteristics for each selected task and using a scale of 0-4, 0 indicating not important and 4 indicating key importance to the particular task.

During the next reporting period, we will continue to set-up and perform initial interviews. An updated copy of the task list is attached, indicating what has been done and dates, as well as responsibilities for making initial contacts.

Expenditures for this reporting period totaled $3,236.28, leaving a balance of $52,141.32 of the original $65,909 contract amount.

Approved:

Richard B. Curtin
Vice President
Automation & Data Systems Division

Sincerely,

Pamela K. Fink, Ph.D.
Manager
Artificial Intelligence Section

RBC/PKF/em

Enclosure

cc: Nancy Bell, RICIS
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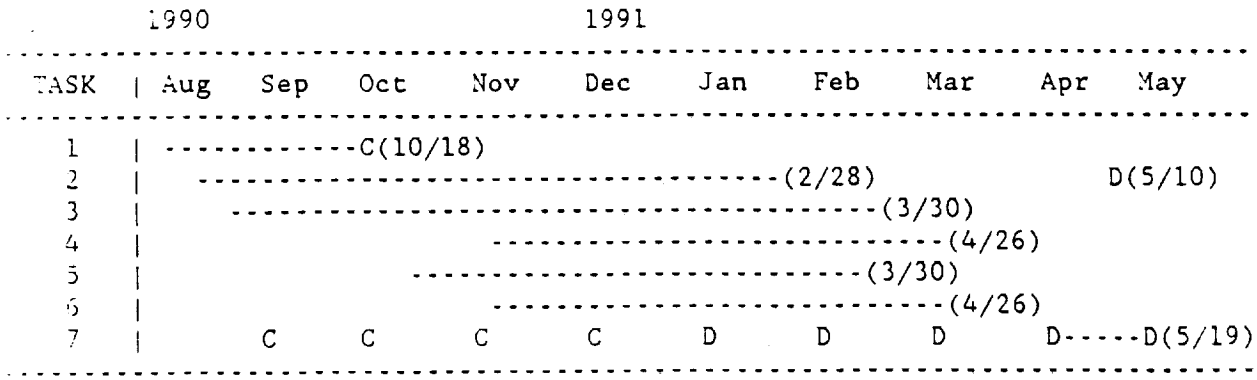
SCHEDULE FOR RESEARCH IN DEVELOPMENT
OF A KNOWLEDGE ENGINEERING TAXONOMY

Months from Date of Award



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TASK/JOB LIST FOR
KNOWLEDGE ENGINEERING TAXONOMY

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2. repair systems/making the fix
3. communications monitoring/analysis
4. photo analysis
5. training pilots
6. training astronauts
7. training air crews (groups to work together)
8. training instructors
9. air traffic control
10. console operations
11. weather forecasting/modelling
12. program management
13. facilities management
14. cargo loading
15. operating a piece of equipment
16. software design
17. software maintenance/debugging
18. form fill-out
19. training reading
20. training foreign language
21. oil accident investigation
22. prospecting
23. power grid management

24. computer configuration
25. chemical analysis
26. personnel management
27. customer service
28. sales
29. weapons director/air intercept
30. use RMS/other remote manipulator
31. leadership training
32. surgery
33. medical diagnosis
34. accounting
35. marketing/advertising
36. knowledge engineering
37. scientific protocol design

Based on the preliminary analysis, a set of distinctive attributes about tasks became apparent. The set of tasks that should be analyzed further should include at least one representative of each of the following:

1. diagnostic task
2. training task
3. high performance task
4. form fill-out
5. people-oriented (soft) task
6. design task
7. planning task
8. monitoring with a time factor
9. perceptually-oriented task
10. bin-packing/np-complete task

11. numerical task

12. data intensive (no real time factor), ie. acquire and present

The following is the list of selected tasks/jobs for which an initial interview will be performed (dates indicate date of initial interview):

1. (diagnostics) medical diagnosis - HRL

2. (diagnostics) equipment diagnosis - HRL

3. (training) training pilots - HRL/Randolph

4. (training) training a foreign language - HRL

5. (high performance) flight controller console operations - Matt Barry, NASA/JSC - Dec.11

6. (high performance/KR) surgery - HRL/BAMC

7. (form fill-out) - Bill Bayliss, SwRI Contracts - Oct. 26, 1990

8. (people-oriented) personnel management - HLR/Leadership Training

9. (design) sofware design - Susan Crumrine, SwRI - ??

10. (planning) acquisition program management - Xavier Pena, Kelly AFB - Dec. 4, 1990

11. (monitoring/time) air traffic control - Jim Johnson, FAA Academy - Nov. 1, 1990

12. (perceptual) - HRL

13. (bin-packing) cargo loading - HRL/Kelly

14. (numerical) accounting - Linda Boehme, SwRI CPA - ??

15. (data intensive/no time) - DRAIR Preparation - Gail Davis/OO-ALC

16. (planning) scientific protocol design - Herb Peel, SwRI - October 18, 1990

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January 10, 1991

Intelligent Systems Evaluation
Training Systems Division
AFHRL/ID
Brooks AFB, TX 78235

Attention: Kurt Steuck, Ph.D.

Subject: Monthly Progress Report from November 24 Through December 21, 1990; Research Activity No. ET.26; NASA Cooperative Agreement NCC9-16; Southwest Research Institute (SwRI) Project No. 05-3744

Gentlemen:

During this reporting period, we have continued to set-up and perform the initial interviews in the areas agreed upon. We have completed interviews in planning (acquisition program management), high performance (shuttle flight control), form fill-out, design (software design), a numerical task (accounting), a data intensive/no time constraint task (deficiency report analysis), and planning (scientific protocol design). These seven problem solving domains, along with the monitoring-with-time-constraint task (air traffic control) have been analyzed and values of 0-4 have been entered for each attribute on the task vs. characteristics matrix that we are maintaining (0 meaning not used and 4 meaning essential). We plan to put this data into a spread sheet or database so that further analysis of similarities and differences between tasks can be made.

We met with Capt. B. J. Jones on December 20, 1990 to discuss the potential for the Air Force to provide contacts in the remaining eight areas. We felt that their contacts would be better than any that we could find. We agreed to try to complete the initial round of interviews by late January or early February, depending on the accessibility of the experts. We also discussed with Capt. Jones what we thought we had learned so far from this process and our tentative plans for carrying-out the second set of interviews. The initial interview seems to take about 1 to 1.5 hours. We have found that the structure we have used in this initial interview has allowed us to get better information in less time than we have experienced in past developments. The questionnaire helps us to stay on track and the experts, so far, seem to really enjoy it. From this initial set of interviews we hope to develop some guidelines for how to proceed with the second interview. For example, we hope to generate rules such as "if the problem solving task has characteristics A, B, or C, then have the expert select some examples to work through" or "If the problem solving task has characteristics X and Y, then ask the following types of questions....".

During the next reporting period, we will continue to set-up and perform initial interviews. We plan to complete at least three of the remaining eight. The rest, five in all, will most likely take place in early February.

Expenditures for this reporting period totaled $3,854.92, including $118 in travel, leaving a balance of $48,136.40, including $150 of commitment for travel, of the original $65,909 contract amount.

Approved:

Richard B. Curtin
Vice President
Automation & Data Systems
Division

Sincerely,

Pamela K. Fink, Ph.D.
Manager
Artificial Intelligence
Section

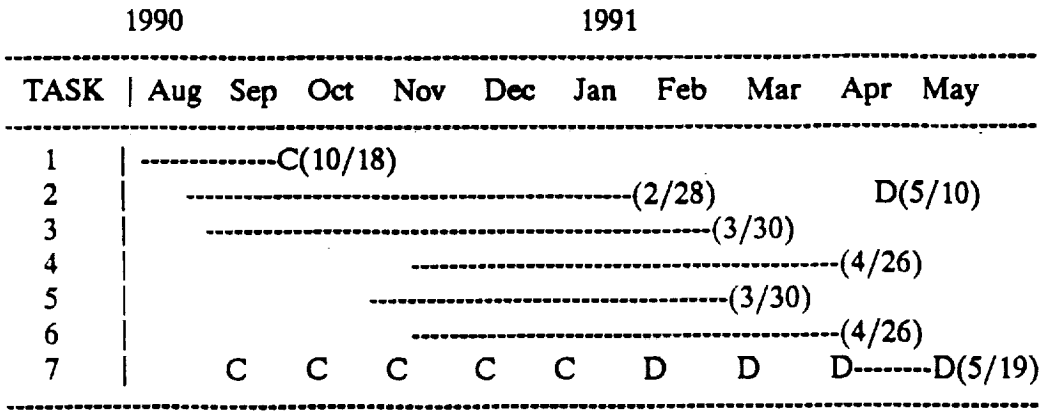
RBC/PKF/em

Enclosure

cc: Nancy Bell, RICIS
Bill Bayliss, SwRI
Tandy Herren, SwRI

SCHEDULE FOR RESEARCH IN DEVELOPMENT
OF A KNOWLEDGE ENGINEERING TAXONOMY

Months from Date of Award



List of Tasks:

Task 1 - Identification of a Set of Specific Problem Solving Tasks

Task 2 - Definition of Identified Problem Solving Tasks

Task 3 - Analysis of Identified Problem Solving Tasks

Task 4 - Development of a Proposed Taxonomy of Problem Solving Tasks

Task 5 - Analysis of Knowledge Engineering Techniques Used in Task 2

Task 6 - Matching of Knowledge Engineering Techniques to Problem Solving Tasks

Task 7 - Reporting